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The *Cis bilamellatus* species-group (Coleoptera, Ciidae) in southern Africa: *Cis mooihoekite* sp. n. and new distributional records

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Abstract

Cis mooihoekite **sp. n.** is described based on specimens collected at two localities in the province of Mpumalanga, South Africa. The new species is included in the *Cis bilamellatus* species-group, which comprises species with a single plate on both anterocephalic edge and anterior pronotal edge in males, females with pronotum usually widest near the posterior end and gradually narrowing anteriorly and both sexes with dual elytral vestiture. *Cis mooihoekite* **sp. n.** can be distinguished from the other South African species in the group by the pronotum devoid of a median impunctate line, pronotal plate angularly emarginate forming two small and triangular horns with acute apex and anterocephalic edge with very acute corners. New geographical records and information on the host fungi of *Cis pickeri* Lopes-Andrade, Matushkina, Buder & Klass, 2009 are provided.

Keywords

Minute tree-fungus beetles, Ciinae, Ciini, Ethiopian, Western Cape Province

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Introduction

Cis Latreille is the most diverse genus of Ciidae with about 400 described species and a worldwide distribution (Lopes-Andrade et al. 2009, Oliveira et al. 2013, Lawrence 2016). It includes more than half of all described Ciidae species and some of them are organised into artificial species-groups (Lawrence 1971, Lopes-Andrade 2008, Oliveira et al. 2013, Lawrence 2016).

The sub-Saharan Ciidae are represented by 72 described species (Lopes-Andrade et al. 2009, Orsetti and Lopes-Andrade 2016, Souza-Gonçalves and Lopes-Andrade 2017), of which 49 belong to *Cis*. In southern Africa, comprising Botswana, Lesotho, Namibia, Republic of South Africa, Swaziland and the southern tip of Mozambique, there are 16 described species of *Cis*: *C. afer* Fähraeus, 1871, *C. aster* Souza-Gonçalves & Lopes-Andrade, 2017, *C. bimucronatus* Motschoulsky, 1851, *C. caffer* Fähraeus, 1871, *C. capensis* Mellié, 1849, *C. delagoensis* Pic, 1916, *C. makebae* Souza-Gonçalves & Lopes-Andrade, 2017, *C. mandelai* Souza-Gonçalves & Lopes-Andrade, 2017, *C. masekelai* Souza-Gonçalves & Lopes-Andrade, 2017, *C. muriceus* Mellié, 1849, *C. neserorum* Souza-Gonçalves & Lopes-Andrade, 2017, *C. stalsi* Souza-Gonçalves & Lopes-Andrade, 2017, *C. pickeri* Lopes-Andrade, Matushkina, Buder & Klass, 2009, *C. regius* Orsetti & Lopes-Andrade, 2016, *C. testaceus* Fähraeus, 1871 and *C. urbanae* Souza-Gonçalves & Lopes-Andrade, 2017.

Cis pickeri is the only species belonging to the *Cis bilamellatus* species-group described from the Ethiopian region (biogeographic regions *sensu* Morrone 2015). The *bilamellatus*-group also includes nine more species described from other biogeographic regions: *C. australis* Blackburn, 1888, *C. bilamellatus* Wood, 1884, *C. biscutatus* Fauvel, 1904, *C. clarki* Blair, 1940, *C. laminicollis* Blair, 1940, *C. lineatosetosus* Pool, 1917, *C. setiferus* Blackburn, 1888 and *C. walkeri* Blair, 1940, from the Australian region; and the Palaearctic *C. onyosi* Viñolas & Muñoz-Batet, 2015, described from a single locality in Spain and recently reported from France (Rose 2017, Viñolas and Muñoz-Batet 2015). There are several undescribed species from the Neotropical and Oriental regions that could be placed in this group (Araujo et al. 2015, Lawrence 2016, Lopes-Andrade pers. obs.). *Cis bilamellatus* was introduced into southeast England during the nineteenth century and has subsequently expanded its distribution to Wales, southern Scotland, Ireland, the Channel Islands and north-west France (Orledge et al. 2010). Recently, it has also been recorded from Chile (Lopes-Andrade and Lüer 2014), making it one of the most widespread and successful invasive ciid species in temperate and subtropical areas.

The aim of this paper is to describe a new species of *Cis* belonging to the *bilamellatus*-group and provide new geographical records of this group in southern Africa.

Materials and methods

Museum abbreviations are as follows:

ANIC Australian National Insect Collection, CSIRO Entomology (Canberra, Australian Capital Territory, Australia)

CELC Coleção Entomológica do Laboratório de Sistemática e Biologia de Coleoptera da Universidade Federal de Viçosa (Viçosa, Minas Gerais, Brazil)
CMN Canadian Museum of Nature (Ottawa, Ontario, Canada)
SANC South African National Collection of Insects (Pretoria, Gauteng, South Africa)

The new species described here and additional material of *C. pickeri* were collected and documented by the staff of the SANC, mostly during ten years of a project on parasitoids of Ciidae in South Africa (Neser 2012). The original coding of the morphospecies (Neser 2012) has been revised and some of them have been described (Orsetti and Lopes-Andrade 2016, Souza-Gonçalves and Lopes-Andrade 2017).

Terms for external morphology and male terminalia of ciids follow Lawrence et al. (2011), Lawrence (2016) and Lopes-Andrade and Lawrence (2005, 2011), but see also Oliveira et al. (2013) for an explanation on the use of "tegmen". The following abbreviations are used for measurements (in mm) and ratios: BW (basal width of scutellar shield), CL (length of antennal club measured from base of the eighth to apex of the tenth antennomere), EL (elytral length along the midline), EW (greatest width of both elytra), FL (length of antennal funicle measured from base of the third to apex of the seventh antennomere), GD (greatest depth of body measured in lateral view), GW (greatest diameter of eye), PL (pronotal length along midline), PW (greatest pronotal width), SL (length of scutellar shield), TL (total length counted as EL+PL, i.e. excluding head). The GD/EW and TL/EW ratios indicate the degree of body convexity and elongation, respectively.

Transcription of labels, dissection, photography and measurement of specimens follow the methods provided by Araujo and Lopes-Andrade (2016). Specimens of the new species were measured from all localities. The number of measured specimens depended on the number of available specimens and the observed variation in size. Differences are given in "Variation", together with standard measurements (mean and standard deviation) and ratios. Discussion about the morphology of female terminalia of the *bilamellatus*-group was not possible due to low availability of specimens for dissection or to lack of data in literature. Data on host fungi extracted from labels are summarised in the sections "Host fungi", together with corresponding number of records in each fungus species and indicating breeding records. The criteria, provided in Orledge and Reynolds (2005) for determining breeding records, have been followed. The distribution map (Fig. 13) was created in the freeware QGIS 2.14.2-Essen.

Results

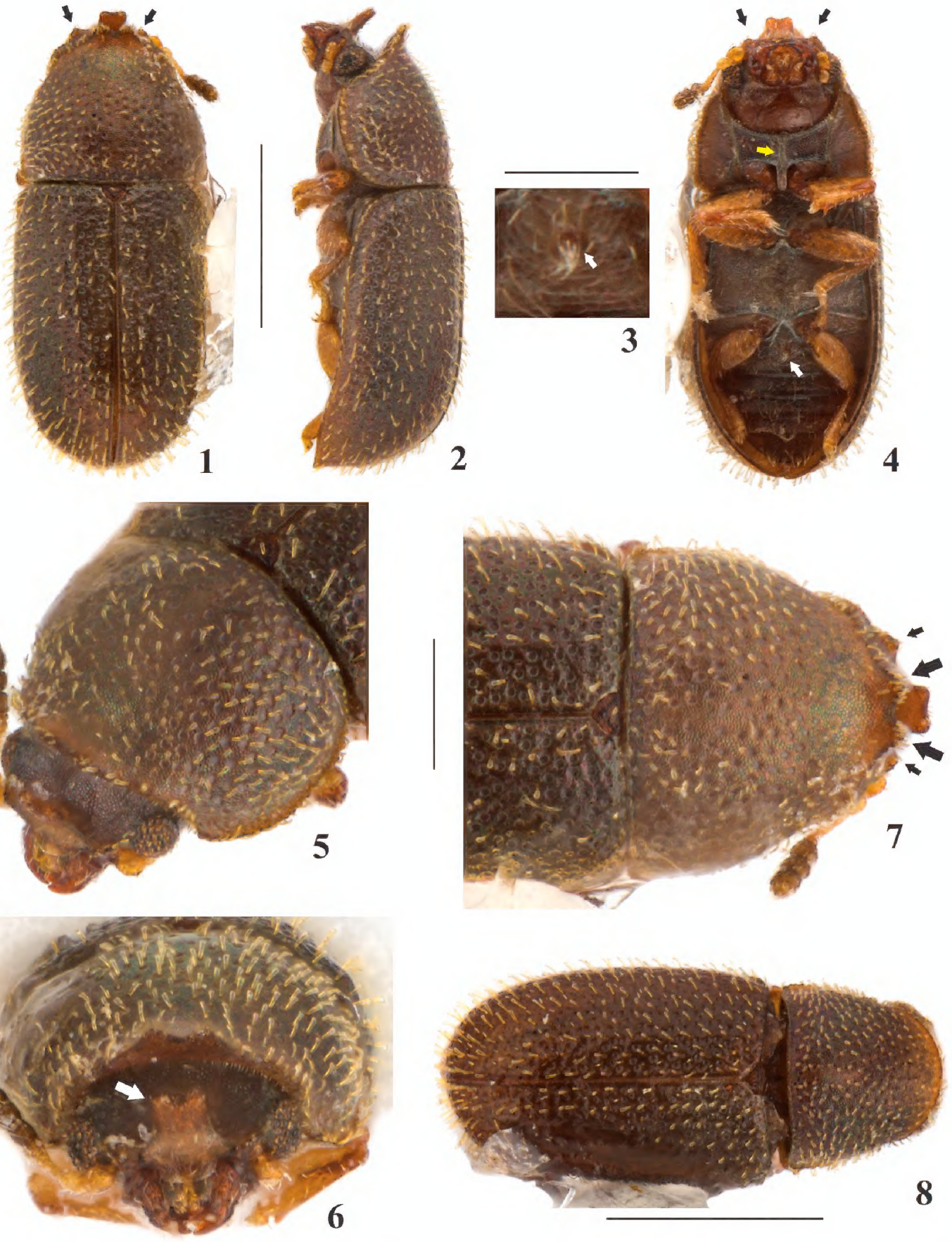
***Cis mooihoekite* Souza-Gonçalves & Lopes-Andrade, sp. n.**
http://zoobank.org/03353CBF-C605-417C-957D-E3B1CC8DF17E
Figs 1–12

Type locality. "Mooihoek Farm" (near Wakkerstroom), coordinates 27°13'S, 30°32'E (Pixley Ka Seme Local Municipality, Gert Sibande District, Mpumalanga Province).

Etymology. The species name refers to the mooihoekite, a copper iron sulphide mineral, which was discovered in 1972 in South Africa and bears a sheen that resembles the dorsal colour of this species.

Diagnosis. The new species differs from *C. pickeri*, as described by Lopes-Andrade et al. (2009), in the following features: TL less than 1.30 mm; pronotum devoid of a median impunctate line; male with anterocephalic edge with acute corners (Figs 1, 4 and 7) and pronotal plate angularly emarginate forming two small and triangular horns with acute apex (Fig. 7); male abdominal sex patch about one-quarter of the length of the first ventrite at midline (Figs 3 and 4).

Male holotype (Figs 1–7). Adult fully pigmented and in good condition, except for lacking the left antenna and five tarsi. Measurements in mm: TL 1.19, PL 0.43, PW 0.51, EL 0.77, EW 0.53, GD 0.39. Ratios: PL/PW 0.84, EL/EW 1.46, EL/PL 1.81, GD/EW 0.74, TL/EW 2.27. Body elongate, convex, dorsum and venter reddish-brown; antennae yellowish-brown with darker club, palpi and tarsi yellowish-brown; dorsal vestiture distinctly dual, consisting of suberect and decumbent pale yellowish bristles easily discernible at high magnifications (90×); ventral vestiture of decumbent pale yellowish setae easily discernible at high magnifications (90×). Head (Figs 4–5) with anteriormost portion visible from above; dorsum with few shallow and sparse punctures, subglabrous, with microreticulate and dull sheen interspaces; anterocephalic edge with acute corners (Figs 1, 4 and 7), mesally raised and produced forming a short narrow lamina (Fig. 6) with an emarginate apex. Antennae with ten antennomeres, lengths as follows (in mm, right antennae measured): 0.05, 0.04, 0.03, 0.02, 0.01, 0.01, 0.01, 0.03, 0.02, 0.04 (FL 0.08 mm, CL 0.09 mm, CL/FL 1.13). Eyes coarsely facetted; with about 50 ommatidia; GW 0.11 mm. Gula 0.48 times as wide as long. Pronotum (Fig. 7) with coarse, deep and single punctation; punctures distributed irregularly, separated from each other by two puncture-widths or less on disc and one puncture-width or less close to the sides; interspaces, microreticulate with a dull sheen; vestiture single, consisting of suberect (0.02–0.03 mm) pale yellowish bristles; anterior edge projected forwards and upwards as a short, broad plate angularly emarginate forming two very close and small triangular horns with acute apex, each bearing a tuft of bristles (Fig. 7); lateral edges finely crenulate, not explanate and not visible when seen from above, except for posteriormost portion. Scutellar shield subtriangular, bearing a few punctures and decumbent bristles; BW 0.07 mm and SL 0.05 mm. Elytra with dense and dual punctation; large punctures coarse, confused, deep, about twice as large as small punctures; irregular interspaces, somewhat rugose and with a dull sheen; vestiture subseriate and distinctly dual, consisting of long (0.03–0.04 mm) suberect and small (0.01–0.02 mm) decumbent pale yellowish bristles, both arising from minute punctures. Metathoracic wings developed, apparently functional. Hypomera with sparse, shallow punctation; each puncture bearing a fine decumbent seta; interspaces, microreticulate and dull sheen. Prosternum biconcave, tumid and bearing a longitudinal carina at midline (Fig. 4); interspaces, microreticulate. Prosternal process parallel-sided, as long as prosternum at midline; apex rounded. Protibiae with maximum width about one-quarter of its length; apical edge devoid of spines; outer apical angle projected in a small tooth.



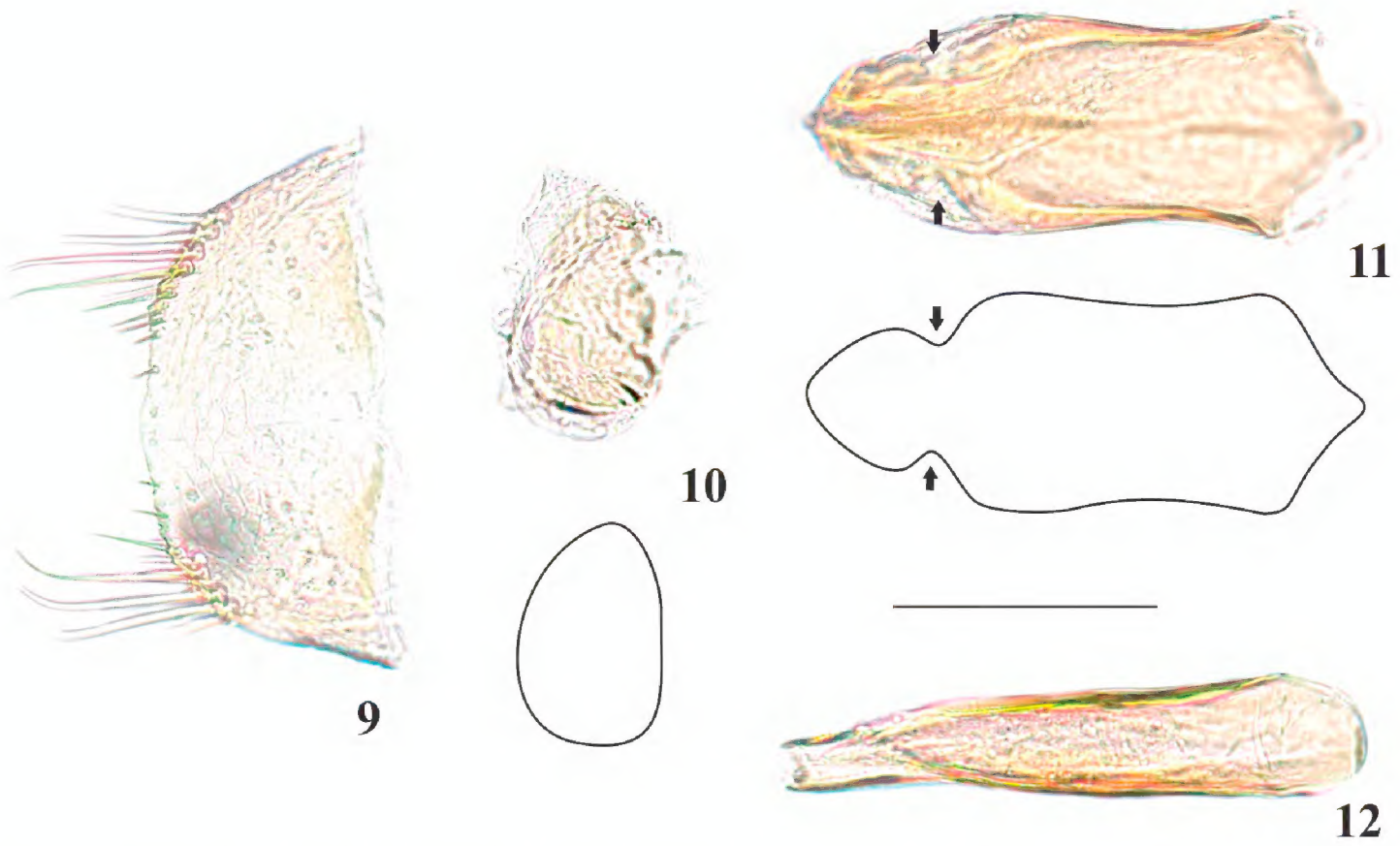
Figures 1–8. *Cis mooihoekite* sp. n. Male holotype (Figs **1–7**): **1** Dorsal view, note acute corners of male anterocephalic edge (arrows) **2** Lateral view **3** Part of first abdominal ventrite, showing sex patch (arrow) **4** Ventral view, note prosternal carina (yellow arrow), abdominal sex patch (white arrow) and acute corners of anterocephalic edge (black arrows) **5** Oblique view of head, pronotum and part of anterior portion of elytra with scutellar shield **6** Frontal view of head and pronotum, note frontal lamina of head (arrow) **7** Dorsal view of anterior portion of elytra with scutellar shield, pronotum and part of head; note small triangular horns of pronotal plate (large arrows) and acute corners of anterocephalic edge (small arrows) **8** Female paratype. Scale bars: 0.5 mm (**1–2, 4, 8**); 0.1 mm (**3**); 0.2 mm (**5–7**).

Meso- and metatibiae without spines on apical edge. Metaventrite with coarse, shallow punctures; interspaces, microreticulate and dull sheen; discrimen about one-quarter the length of metaventrite at midline. Abdominal ventrites with moderately dense, coarse and shallow punctures, separated from each other by one puncture-width or less and each bearing a pale yellowish seta; interspaces, microreticulate and dull sheen; length of ventrites (in mm, from base to apex at the longitudinal midline) as follows: 0.14, 0.06, 0.06, 0.06, 0.07; first abdominal ventrite bearing a margined, circular, fully exposed sex patch at middle, with a transverse diameter of 0.03 mm (Figs 3 and 4).

Male paratypes. Terminalia (Figs 9–12) with sternite VIII (Fig. 9) with posterior margin subrounded, bearing short setae at middle and long setae at corners; anterior portion membranous. Tegmen (Fig. 11) about 2.6x as long as wide, widest near apex; sides more or less parallel-sided, but somewhat sinuate near apex; apex with a small emargination on both sides (visible in the dorsal view; Fig. 11); base triangular. Basal piece (Fig. 10) subrounded, about 1.7x as wide as long. Penis (Fig. 12) about as long as tegmen, about 4.7x as long as wide; subcylindrical, parallel-sided along basal three-fifths and then converging to apex, which bears a slight emargination; base rounded. Measurements in mm (n = 4): TL 1.20–1.25 (1.21 ± 0.03), PL 0.43–0.45 (0.44 ± 0.01), PW 0.45–0.48 (0.47 ± 0.01), EL 0.75–0.80 (0.77 ± 0.02), EW 0.50–0.53 (0.51 ± 0.02), GD 0.38–0.43 (0.39 ± 0.02). Ratios (n = 4): PL/PW 0.89–1.00 (0.89 ± 0.04), EL/EW 1.43–1.55 (1.50 ± 0.05), EL/PL 1.67–1.82 (1.73 ± 0.08), GD/EW 0.75–0.81 (0.77 ± 0.03), TL/EW 2.29–2.40 (2.37 ± 0.05).

Female paratypes (Fig. 8). Anterior edge of head truncate, not raised nor produced. Pronotum widest near the posterior end and gradually narrowing anteriorly; anterior edge of pronotum rounded, not developed. Protibia with outer apical angle not toothed but expanded and with several socketed spines along the apical edge. Otherwise like males, but without an abdominal sex patch. Measurements in mm (n = 3): TL 1.13–1.25 (1.18 ± 0.06), PL 0.38–0.45 (0.42 ± 0.04), PW 0.43–0.53 (0.47 ± 0.05), EL 0.75–0.80 (0.77 ± 0.03), EW 0.50–0.60 (0.55 ± 0.05), GD 0.40–0.43 (0.42 ± 0.01). Ratios (n = 3): PL/PW 0.86–0.94 (0.89 ± 0.04), EL/EW 1.33–1.50 (1.40 ± 0.09), EL/PL 1.76–2.00 (1.85 ± 0.13) GD/EW 0.73–0.85 (0.76 ± 0.08), TL/EW 2.08–2.25 (2.16 ± 0.09).

Type series. Holotype: ♂ (SANC) "SOUTH AFRICA: MPU, Mooihoek Farm nr Wakkerstroom, 27°13'S, 30°32'E, 15.vii.2008, O&S Neser \ Ex bracket fungus *Thelephora* sp., BF#125 \ NATIONAL COLL. OF INSECTS Pretoria, S. Afr. \ *Cis mooihoekite* Souza-Gonçalves & Lopes-Andrade HOLOTYPUS [red paper]". Paratype: ♂ (CELC, dissected) "SOUTH AFRICA: MPU, Mooihoek Farm nr Wakkerstroom, 27°13'S, 30°32'E, 15.vii.2008, O&S Neser \ Ex bracket fungus *Coriolus versicolor*, BF#140 \ NATIONAL COLL. OF INSECTS Pretoria, S. Afr."; ♂ (ANIC) and ♀ (SANC) "SOUTH AFRICA: MPU, Mooihoek Farm nr Wakkerstroom, 27°13'S, 30°32'E, 15.vii.2008, O&S Neser \ Ex bracket fungus, BF#129 \ Ex bracket fungus *Coriolus versicolor*, BF#129 \ NATIONAL COLL. OF INSECTS Pretoria, S. Afr."; 2 ♂♂ (1 CELC; 1 CMN) and 2 ♀♀ (1 CELC; 1 CMN) "RSA: Transvaal, 11 Km SE PilgrimsRest [sic], 1400m, 11–31.xii.85, S & J Peck, relict native forest edge FIT-malaise". All paratypes additionally labelled "*Cis mooihoekite* Souza-Gonçalves & Lopes-Andrade PARATYPUS [yellow paper]".



Figures 9–12. *Cis mooihoekite* sp. n., sclerites of aedeagus of a paratype from the type locality; the anterior ends are placed to the right and the posterior ends are placed to the left. **9** Sternite VIII **10** Basal piece (top) and gross outline of basal piece (bottom) **11** Tegmen (top) and gross outline of tegmen excluding membranes (bottom), note emarginations near apex (arrows) **12** Penis. Scale bar: 0.1 mm.

Host fungi. *Thelephora* sp. (Thelephoraceae), one record; and *Trametes versicolor* (L.) Lloyd (Polyporaceae), two records.

Distribution. *Cis mooihoekite* sp. n. was collected in two localities: one in the northern Mpumalanga, dominated by Grassland (Mooihoek Farm); and the other in southern Mpumalanga, dominated by Savannah (Transvaal). Both localities are 1,000 m a.s.l. and have urban areas (Fig. 13).

Comments. This species corresponds to *Cis* sp. I in Neser (2012) and was collected together with *C. neserorum*, the morphospecies *Cis* sp. C, *Cis* sp. Q (see explanation on morphospecies' coding in the section on Materials and Methods), *Xylographus madagascariensis* Mellié, 1849, the invasive species *Ceracis tabellifer* (Mellié, 1849) and the parasitoids *Astichus micans* Neser, 2012 (Hymenoptera: Eulophidae: Entiinae) and *A. silvani* Neser, 2012.

Cis pickeri Lopes-Andrade, Matushkina, Buder & Klass, 2009

Additional material. 10 ♂♂ (4 CELC; 6 SANC) and 7 ♀♀ (2 CELC; 5 SANC) "SOUTH AFRICA, W.Cape, Palmiet River R. nr. Kleinmond, 34°20'S, 18°58'E, 6.iv.2008, S. Neser \ Ex bracket fungus, BF#71 \ NATIONAL COLL. OF INSECTS Pretoria, South Africa"; 3 ♂♂ (1 CELC; 2 SANC) "SOUTH AFRICA, WCAPE, Prince Alfred'S, Pass N of Knysna, 33°58'S, 23°09'E, 5.xi.2009, S & OC Neser \ Ex bracket fungus #213 \ Ex bracket fungus *Coriolus versicolor*, BF#213 \ NATIONAL

COLL. OF INSECTS Pretoria, South Africa"; 4 ♂♂ (2 CELC; 2 SANC) and 5 ♀♀ (2 CELC; 3 SANC) "SOUTH AFRICA WCape, Garden of Eden Indig. Forest, nr. Knysna, 34°02'S, 23°12'E, 1.iii.1991, AJ Hendricks \ Emerged from log of *Nuxia floribunda* BUDDLEJACEAE, UA677B \ NATIONAL COLL. OF INSECTS Pretoria, South Africa"; 5 ♀♀ (2 CELC; 3 SANC) "SOUTH AFRICA WCape, Heatherlands, George, 33°57'S, 22°57'E, 11.iv.1990, AJ Urban \ Emerged from *Dais cotinifolia* THYMELAEACEAE, with fruiting body of fungus ?*Lenzites*, UA601 \ NATIONAL COLL. OF INSECTS Pretoria, South Africa"; ♀ (SANC) "SOUTH AFRICA WCape, Woodifield Farm nr. George, 33°58'S, 22°32'E, 9.iv.1990, AJ Urban & AJ Hendricks \ Adults collected on dry fruiting bodies of *Russula capensis* BASIDIOMYCETE [sic] on *Pinus radiata*, UA598 \ NATIONAL COLL. OF INSECTS Pretoria, South Africa". All additionally labelled "*Cis pickeri* Lopes-Andrade *et al.*, 2009; I. Souza-Gonçalves det.".

Host fungi. *Laetiporus* sp. (Fomitopsidaceae), one record; *Russula capensis* A. Pearson (Russulaceae), one record; and *Trametes versicolor* (L.) Lloyd (Polyporaceae), one breeding record.

Distribution. *Cis pickeri* was described based on specimens from two field collections: one during the Swedish South Africa Expedition in the 1950s (at Viljoenspas) and the other to the Western Cape Province in 2003 (at Ceres) (Lopes-Andrade et al. 2009). The field collections made by the staff of the SANC during a project on ciid parasitoids (Neser 2012) resulted in five additional localities for this species: Palmiet River Nature Reserve, Prince Alfred'S, Pass, Garden of Eden, Heatherlands and Woodifield Farm. All localities in which *C. pickeri* occurs are areas of Fynbos vegetation (Fig. 13).

Comments. This additional material was collected together with *C. neserorum*, the morphospecies *Cis* sp. C, *Cis* sp. D, *Cis* sp. H, *Cis* sp. J, *Cis* sp. Q, *Cis* sp. S, *Cis* sp. Y (see explanation on morphospecies' coding in the section on Materials and Methods) and the invasive species *Cer. tabellifer*.

Discussion

Cis mooihoekite sp. n. is here included in the *bilamellatus*-group, which is characterised by the following features (based on Lawrence 2016): (i) presence of a single plate on both anterocephalic edge and anterior pronotal edge in males; (ii) females with pronotum usually widest near the posterior end and gradually narrowing anteriorly; (iii) dual elytral vestiture (sometimes difficult to determine); and (iv) outer apical angle of protibia toothed in males but expanded with several socketed spines in females. Information on the morphology of sclerites of male terminalia is available for species of the *bilamellatus*-group, except for *C. biscutatus* and *C. lineatosetosus* (Lopes-Andrade et al. 2009, Lawrence 2016). The aedeagus is characterised by tegmen widest at middle or widest near apex, usually bearing an emargination on both sides of the apex and penis usually subcylindrical and without struts, as long as or slightly longer than tegmen.

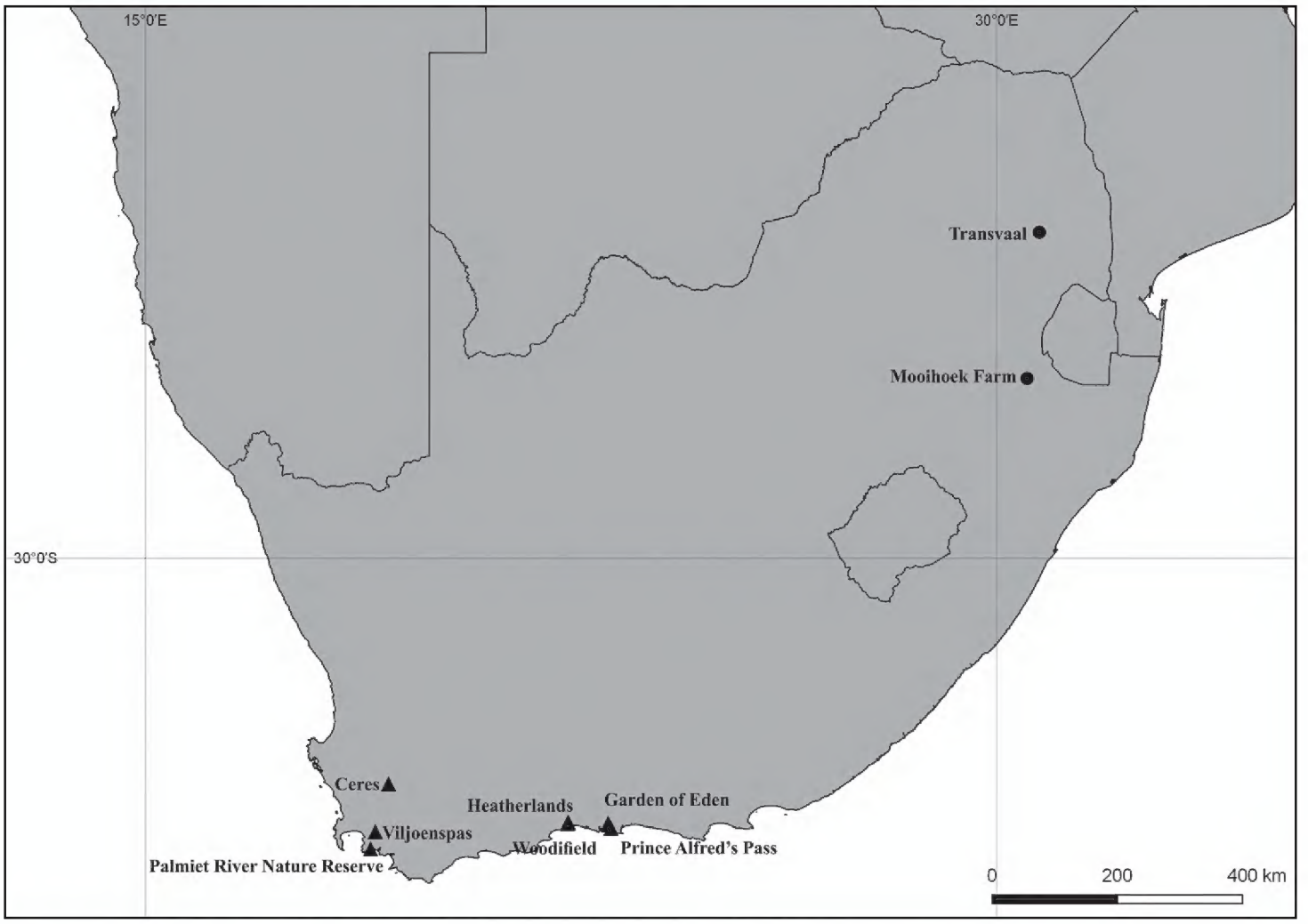


Figure 13. Known distribution of southern African species of the *bilamellatus*-group: *Cis mooihoekite* sp. n. (black circle) and *Cis pickeri* Lopes-Andrade, Matushkina, Buder & Klass (black triangle).

Amongst African species, *Cis mooihoekite* sp. n. not only differs from *C. pickeri* in the features mentioned in the section on "Diagnosis", but also in its geographic distribution. *Cis mooihoekite* sp. n. occurs only in areas of Grassland or Savannah at Mpumalanga Province, far from the coast, while *C. pickeri* occurs only in areas of Fynbos vegetation at Western Cape Province, close to the coast (Fig. 13).

Amongst non-African species of the *bilamellatus*-group, *Cis mooihoekite* sp. n. mostly resembles *C. onyosi* from Spain and *C. clarki* and *C. setiferus* from Australia. It differs from *C. onyosi* in the anterocephalic edge with corners more acute and further away from the median anterocephalic plate (Fig. 7) and the comparatively more trapezoidal pronotum with straight base (Viñolas and Muñoz-Batet 2015) (Fig. 7); it differs from *C. setiferus* in bearing smaller and margined abdominal sex patch (Figs 3 and 4) and anterocephalic edge with corners more acute (Lawrence 2016) (Figs 1, 4 and 7); and from *C. clarki* in the smaller body length and male abdominal sex patch, larger and less seriate elytral punctures, comparatively shorter pronotal plates and anterocephalic edge with acute corners (Lawrence 2016).

Except for *C. onyosi*, all described species of the *bilamellatus*-group occur in the Southern Hemisphere, mostly in subtropical and temperate areas (Lopes-Andrade et al. 2009, Lawrence 2016). The occurrence of *C. onyosi* in Europe, recently described

from Spain and reported from France (Rose 2017, Viñolas and Muñoz-Batet 2015), may well be a case of biological invasion. In such case, *C. onyosi* would be the second invasive species of the *bilamellatus*-group to reach the Northern Hemisphere, after *C. bilamellatus* (Orledge et al. 2010).

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